A

Patent Application
Docket No. 27757-403
P-98-2336

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Henry M. D'Souza

For: A METHOD AND APPARATUS FOR COMPUTING OPTIMUM POLYNOMIAL COEFFICIENTS TO REPRESENT THE INPUT-OUTPUT CHARACTERISTICS OF A COLOR DISPLAY DEVICE

BOX: PATENT APPLICATION
Assistant Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

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Type or Print Name PAMELA K. KERR

Pamela K. Kerr
Signature

Dear Sir:

REQUEST FOR FILING A NATIONAL PATENT APPLICATION

Transmitted herewith for filing, please find the following:

X 1. Specification, claims and abstract of the above-referenced patent application having 34 pages.

X 2. Three (3) sheets of drawings (Figs. 1-3) (____ formal / X informal).

X 3. Declaration (X signed ___ unsigned).

___ 3A. No filing fee, Oath, or Declaration is enclosed pursuant to 35 U.S.C. 53(d).

X 4. Power of Attorney By Assignee (X signed ___ unsigned).

___ 5. Information Disclosure Statement along with Form PTO-1449 and references.

___ 6. This is a: ____ CIP, ____ DIV, ____ CONT, or ____ substitute Application (MPEP 201.09) of Application Serial No. ____ filed ____; or, is a ____ reissue of U.S. Patent No. ____ filed on ____.

An extension to extend the life of the above prior Application to at least the date of filing hereof

(a)____ is concurrently being filed in that prior Application,
(b)____ was previously filed in that prior Application (check length of prior extension),
(c)____ is not necessary for <u>copendency</u> (double check before X'ing this).

_X_ 7. Attached is an assignment to COMPAQ COMPUTER CORPORATION. <u>Please return the recorded assignment to the undersigned</u>.

_____ 8. Priority is claimed under 35 U.S.C. § 119 based on filing in <u>(Country)</u>.

	Application No.	Filing Date
(1)	____	____
(2)	____	____
(3)	____	____

____ (No.) Certified copy (copies) ____ are attached; or ____ were previously filed on ____.

____ 9. Attached: ____ (No.) verified statement(s) establishing "small entity" status under 37 CFR § 1.9 and 1.27.

_X_ 10. Attached:

_X_ Return Postcard
_X_ Filing Fees

___ 11. Preliminary Amendment:

Prior to a first Office Action, kindly amend the Application as follows:

12. The following Filing Fee calculation is based on the claims filed less any claims canceled by the Preliminary Amendment of Item 11.

	NUMBER FILED			NUMBER EXTRA	SMALL ENTITY RATE		LARGE ENTITY RATE		
BASIC FEE					$380	OR	$760	=	$760.00
TOTAL CLAIMS	19	-20	=	0 (at least 0)	x 9	OR	x 18	=	+$ 0
INDEP. CLAIMS	4	- 3	=	1 (at least 0)	x 39	OR	x 78	=	+$ 78.00
If any proper multiple dependent claim (ignore improper) is present (Enter $0.00 if this is a reissue application.)					+$130	OR	+$260	=	+$ 0
If assignment is x'd (line 5), add recording fee $40.00									+$ 40.00
Attached is a Rule 47 Petition (inventor refuses to sign or cannot be reached) $130									+$___
TOTAL FILING FEE									=$ 878.00

X 13. A check in the amount of $878.00 is enclosed to cover the Filing Fees calculated in Item 12. Please charge any deficiency or credit any overpayment to Deposit Account No. 10-0447.

___ 14. Please charge Deposit Account No. 10-0447 in the amount of $_______ to cover the Filing Fee calculated in Item 12. This sheet is attached in duplicate.

X 15. The Commissioner is hereby authorized to charge any fee specifically authorized hereafter, or any missing or insufficient fee(s) filed, or asserted to be filed, or which should have been filed herewith or concerning any paper filed hereafter, and may be required under 37 CFR 1.16-1.18 (missing or insufficiencies only) now or hereafter relative to this application and for the resulting Official Document under 37 CFR 1.20, OR credit any overpayment to my Deposit Account No. 10-0447, **for which purpose a duplicate copy of this sheet is attached.**

The Commissioner <u>is not authorized</u> to charge the <u>issue fee</u> until/unless an issue fee transmittal form is filed.

Respectfully submitted,

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A METHOD APPARATUS FOR COMPUTING OPTIMUM POLYNOMIAL COEFFICIENTS TO REPRESENT THE INPUT-OUTPUT CHARACTERISTICS OF A COLOR DISPLAY DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to color monitors and displays, and more particularly the present invention relates to calibrating and standardizing the output of a color display device.

Description of Related Art

The currently accepted method of characterizing the input-output of an analog RGB color CRT monitor is to assume that the input voltage to the monitor is related

to the output brightness of the monitor by a "gamma" function. The gamma function is utilized to define the relationship between the input voltage and the output brightness of the monitor. The brightness of the monitor should be equal to a constant multiplied by the input voltage raised to the power of gamma. Gamma is a rational number between zero and infinity which is provided by a monitor's manufacturer and is based on measurements made by the manufacturer. Via experimental observation, it has been determined that the gamma function, though the standard in the industry, is inaccurate. The gamma function can provide an error that can exceed 4 foot-lamberts over the full brightness range of the monitor; the gamma number is generally an estimation by the CRT's manufacturer based on empirical measurements on a specific monitor and then averaged or generalized for all similar monitors.

Furthermore, color monitors generally generate a color picture via a brightness mixture of red, green and

blue. Since red, green and blue are generated by separate circuits, the gamma function for each should be different. To date, only a single gamma is used for all three colors.

The importance of accurate color is becoming of paramount importance in the computer monitor industry. The need for and importance of accurate color has come about, to some degree, due to the increased amount of commerce taking place on the World Wide Web or Internet. For example, an Internet site might sell clothing. The site owner would like the correct color of the clothing to be displayed on the viewer's monitor so that the viewer will have better confidence when buying the product. At present, the gamma function will not necessarily allow the potential buyer to view the correct color of the clothing. This is a significant problem in the area of standardizing the color in a color display device.

Thus, there is a need for a method of providing a color monitor or color display device the ability to correctly and accurately display the color(s) that should be displayed. Furthermore, there is a need for providing a color monitor that utilizes more than the single gamma number in order to predict and provide a brightness output that is characterized by a standardized signal input-brightness output characteristic. Furthermore, what is needed is a method and apparatus for characterizing each color channel of a color monitor separately in order to enhance color fidelity of a color display device. Also, there is a need for a color display device that stores its own input-to-output brightness characteristics.

SUMMARY OF THE INVENTION

An exemplary embodiment of the present invention may comprise a photometer and video pattern generator that are interfaced to a computer system. The computer system

may be equipped with a means to write to a non-volatile memory within a color display device. A color display device is tested by placing the photometer in front of the display device under test. The computer controls the pattern generator so as to drive the display with incremental input signals corresponding to an output display color. For each incremental input from the pattern generator, the photometer measures the actual brightness output of the color on the color display device and provides the measurement to the computer for storage in a memory device. This is done for each color; red, green and blue, from a maximum brightness to a minimum brightness. After recording all the input signal-to-brightness information for each color, the computer computes coefficients for a third order polynomial for each color channel that best represents the correlation between the incremental inputs and the resulting brightness measurements for each color. In effect, a transfer function is created describing the

signal-input-to-brightness-output characteristics for each color. The transfer function can be a third order polynomial equation. The computed coefficients for the third order polynomial for each color (12 coefficients, 4 for each color red, green and blue) can then be provided to and stored in a non-volatile memory within the display device. The coefficients can then be utilized by display driver circuitry within a computer to which the tested display device is connected. The display driver can utilize the coefficients to help provide an accurate high color fidelity, standardized picture on the monitor.

BRIEF DESCRIPTION OF THE DRAWINGS

Various objects and advantages of this invention will become apparent and more readily appreciated from the following description of the presently preferred exemplary embodiments, taken in conjunction with the accompanying drawings, of which:

FIGURE 1 depicts an exemplary color monitor with an exemplary pixel pattern on the screen;

FIGURE 2 depicts an exemplary method and apparatus for generating a transfer function that represents the input-output characteristics of a color monitor; and

FIGURE 3 depicts a computer system that utilizes transfer function data which is stored in a color display monitor.

DETAILED DESCRIPTION OF A PRESENTLY PREFERRED EXEMPLARY EMBODIMENT

An exemplary embodiment of the present invention prescribes a method for establishing a transfer function, and preferably, a third order polynomial that describes a relationship between an input to a color monitor and the resulting color brightness of the monitor for each color red, green and blue. In essence, a polynomial representation of the input-output characteristics of a color display device is established.

Referring to FIGURE 1, a CRT 10 is depicted. It is noted that this method can be used for substantially any display device. Such display devices include, but are not limited to, color display devices, VGA flat panel NCDs or SPVs, LCD, reflective LCD, and FED display devices **[INVENTORS: PLEASE PROVIDE ENGLISH FOR THE ACRONYMS]**. Regardless, of the type of color display device 0, a video signal (or its equivalent) is inputted into the color display device (CDD) 10 and a pattern is outputted on the CDD's screen. A grid or plurality of pixels 12 make up the displayed pattern. A pixel is a picture element or an addressable element within the displayed image on the CDD's screen.

To simplify, a single pixel 14 can be addressed or illuminated as a result of an input to the CDD 10. The pixel may represent red, blue, or green, or another color used as a pixel on the CDD.

Again, a pixel is essentially an element of a CCD's picture. A CCD's screen is substantially a grid of

pixels to some extent. Focusing, for a moment on a single pixel 14 in an exemplary CCD 10, it is desirable to determine an accurate transfer function that describes the relationship between a voltage input to the CCD 10 and a resulting brightness of the pixel 14.

The present exemplary method of representing the brightness output of a CCD pixel 14 at any given voltage level input, via a signal generator 16, is provided as a polynomial expression. A polynomial expression is chosen because it can provide a more accurate transfer function than the prior art gamma function technique.

In the preferred method and apparatus of the present invention, a third order polynomial transfer function is utilized. It is understood that a second order or higher polynomial could be used depending on how precise a transfer function is required. After various tests, it was established in the lab that a third order polynomial can be utilized to provide a transfer function with an accuracy of better than 0.3 foot-lamberts over the full

range of brightness. This accuracy is not significantly noticeable to the human eye. It is noted that use of the prior art gamma function can generally have an inaccuracy of 3 or more foot lamberts which is easily noticed by the human eye.

To calculate the third order polynomial a least squares technique, which is a well known mathematical technique, is preferably utilized. The third order polynomial transfer function utilized in the present invention and method provides approximately a ten fold increase in accuracy over the prior art gamma function.

The signal generator 16 provides a video signal or other required input signal to the CDD 10 and a visible output pattern is provided on the screen 12 of the CDD. The pattern may include one or more pixels 14 and preferably is in a single color such as red, blue or green. In order to establish a polynomial transfer function, one must look at the brightness of the pixel 14 as a function of the video signal (the input signal). In

other words the pixel 14 has a brightness B which is related to an input voltage V. $B=f(V)$. The brightness B of the pixel 14 must be known to be when the input voltage to the CDD 10 changes. To make the relationship between B brightness and V voltage a third order polynomial relationship the equation

$$B = a_3V^3 + a_2V^2 + a_1V + a_0$$

is utilized. The voltage input is systematically changed from a minimum voltage input to a maximum voltage input in an incremental fashion. Thus, mathematically the voltage is incrementally applied from the signal generator 16 to the CDD 10:

$V \rightarrow V_{min}$ to V_{max} in increments of Δ such that $V_1 = V_{min}$ and $V_{max} = V_N$

$$V_n - V_{n-1} = \Delta$$

The resulting brightness B for each voltage increment will be:

$$B_1, B_2, B_3 \ . \ . \ . B_N \text{ for } V_{min} \text{ to } V_{max}$$

wherein B_1 is the minimum output brightness; B_N is the maximum output brightness, B_{n-1} is equal to the brightness differential between each brightness increment.

Input voltage V_n is applied for each voltage increment between V_{min} and V_{max} and the resulting B_n is measured via, for example, a photometer 18. B_n is represented as a brightness measurement output of the photometer 18. The unit of measurement for brightness is preferably foot lamberts.

The increment (Δ) for the voltage can be, for example, .5 volts or any reasonable voltage increment that provides a good sampling of voltage inputs to brightness outputs. Thus, input/output data can be established.

$$
\begin{array}{l}
V_1 \rightarrow B_1 \\
V_2 \rightarrow B_2 \\
\cdot \quad \cdot \\
V_n \rightarrow B_n \\
V_{max} \rightarrow B_{max}
\end{array}
$$

This can be rewritten as a plurality of polynomial equations and, in particular, a plurality of third order polynomial equations:

$$\begin{aligned} B_1 &= a_3V_1^3 + a_2V_1^2 + a_1V_1 + a_0 \\ B_2 &= a_3V_2^3 + a_2V_2^2 + a_1V_2 + a_0 \\ &\vdots \\ B_{max} &= a_3V_N^3 + a_2V_N^2 + a_1V_N + a_0 \end{aligned}$$

Each B_n and V_n are known quantities and thus, the polynomial only needs to be solved for a_3, a_2, a_1 and a_0. Furthermore, it is understood that generally the increments between each B_n are not equal or necessarily linear. The equation has only four unknowns (a_3, a_2, a_1 and a_0) and the process of creating the equations will produce many more than four equations thereby making this an over determined system. An over determined system can produce, mathematically, very accurate values for the coefficients a_3, a_2, a_1 and a_o.

The plurality of equations can be solved a variety of ways using a variety of techniques known to those having ordinary skill in the art. One technique is to

use matrix techniques to solve for the coefficients a_3, a_2, a_1 and a_0.

$$\begin{bmatrix} B_1 \\ B_2 \\ \cdot \\ \cdot \\ \cdot \\ B_N \end{bmatrix} = [a_3\, a_2\, a_1\, a_0] \begin{bmatrix} V_1^3 & V_3^3 & \cdot\ \cdot & V_N^3 \\ V_1^3 & V_3^3 & \cdot\ \cdot & V_N^3 \\ V_1 & V_3 & \cdot\ \cdot & V_N \\ 1 & 1 & \cdot\ \cdot & 1 \end{bmatrix}$$

Once the equation is solved for the coefficients a_3, a_2, a_1 and a_o, then a sufficiently accurate transfer function is established which can predict a brightness B for any input voltage V applied to the CCD 10. The brightness has been empirically determined to be accurate to within approximately ± 0.3 foot-lamberts if a third order polynomial is utilized.

The above method can be repeated for each color red, blue and green thereby providing four coefficients a_3, a_2, a_1 and a_o for each color, totaling 12 coefficients in all. That is, four coefficients for red, four for green, and

four for blue. Theoretically, one could average or compress each set of four numbers and only have three numbers (one number for each red, green and blue). Also one could average all the a_0s to produce a single A_0 for red, yellow and blue. Then similarly average all the a_1s and a_2s and a_3s to produce only four coefficient numbers for each transfer function. The a_0 coefficient could be dropped and not used when it is an insignificant number. It is understood that any compressing, averaging or deletion of the resulting coefficient numbers will generally decrease the accuracy of the transfer function over the full range V_{min} to V_{max}.

It is further understood that fourth, fifth or higher degree polynomials could be utilized to establish a transfer function relationship between an input to a CDD and the resulting output brightness of each color. The transfer function will have a larger number of coefficients and may provide a high level of accuracy. The accuracy may be misleading or insignificant depending

on various variables such as test equipment accuracy, standardized CDD electronic components, the number of incremental samples taken between V_{min} and V_{max}, just to name a few.

By utilizing the transfer function coefficients established for each CDD 10, then each CDD can be standardized to produce a predictable color brightness. That is, if it is known what voltage is required to produce a predetermined color brightness for any color or combination of colors to within approximately $\pm$ 0.3 foot-lamberts on each color display device, then all color display devices can be significantly standardized to produce substantially similar pictures.

This is an important advancement in color display technology particularly in the area of advertising on the internet. A manufacturer may produce a web site to sell products, for example, clothing, wall paper, title, paint, fabric, pictures, or other manufactured items. The color of the products may be very important to the

buyer. Thus, it would be advantageous to the seller and buyer to know that the color represented on the computer screen is substantially and accurately the same color as to actual product.

In order to provide CDDs that are capable of providing standardized color, the voltage to brightness transfer function of each CDD must be determined at the time the CDD is manufactured. It is understood that the voltage-to-brightness transfer function coefficients are not necessarily the same for each different CDDs even if the CDDs are electronically identical or manufactured next to each other on an assembly line. It is important that the transfer function coefficients be established for each monitor or CDD.

Referring to FIGURE 3, it would be further advantageous for each CDD or monitor 300 to carry a "description of itself" that includes the transfer function coefficients for that CDD in a data storage device 302. The coefficients could be downloaded to a

personal computer 304 (laptop computer, general purpose computer) when the CDD 300 is connected thereto, in order to provide the computer's video driver 306 the coefficients to standardize the brightness output of the CDD.

Referring now to FIGURE 2, a production method and apparatus for determining the transfer function coefficients of a CDD is shown. A monitor 200 is sitting on a production line and comes to a place on the production line wherein testing of the monitor 200 takes place. The monitor 200 is connected to power and allowed to warm up. The monitor 200 is also connected to a VGA connector 202. It is understood that a specific type of connector is not required, the CDD need only be connected to a means for providing a display signal to the CDD. The VGA connector is connected to a signal generator circuit 204. The signal generator 204 receives an input from a control system 206 which could be, for example, a dedicated CPU or general purpose computer.

A photometer 208, or other device for measuring color brightness, is focused to receive input from a predetermined location(s) on the monitor screen 210. The photometer 208 provides a brightness measurement input to the control system 206.

The control system 206 controls the signal generator to provide incremental voltage or video color (V) steps ranging from a V_{min} to a V_{max} for one of the output colors (red, green or blue). The signal generator 204 provides a pattern and voltage level for the color to the monitor 200 via the VGA connector 202. The resulting pattern 212 displayed on the monitor screen 210 could be a red dot or square comprising a plurality of pixel locations. As the voltage input controlling the pattern is incrementally changed from V_{min} to V_{max} or visa=vis, the brightness of the resulting pattern 212 is measured incrementally by the photometer 208. It is understood that the pattern 212 need only be a pattern large enough to be discerned and focused on by the photometer. The patterns shape is not

substantially significant. Furthermore, the pattern could be positioned at one or various locations on the screen 210.

As the voltage input increments, it may stop at each increment and wait for the photometer to read the pattern's brightness. The brightness is then recorded by the control system in conjunction with the voltage that caused the brightness. In essence, a set of ordered pairs is generated as data which correlates the voltage required to produce a specific brightness of the specified color. After the voltage to brightness correlation data for a color is recorded, then voltage to brightness correlation data is obtained for the other predetermined colors. It is further understood that the colors do not have to be limited to the red, green, and blue, but could be combinations of each or whatever the basic colors that are combined to create other colors are for the specific CDD. It is further understood that more

than one color can be displayed on the screen 210 and be recorded by a plurality of photometers at the same time.

After the control system 206 systematically steps through each voltage, measures the corresponding brightness, and stores the data, it rapidly progresses through the linear algebra equations and solves for the coefficients of the polynomial equations discussed above. Coefficients for a transfer function of each measured color are computed. For example, red, green and blue will each have four coefficients if the control system is solving third order polynomial equations for each color.

The control system 206 then writes the coefficients which are used in the voltage to brightness transfer function to the monitor via the VGA connector. In the exemplary method and apparatus the coefficients are stored in the DDC memory 214 located within the color display device.

DDC memory is not specifically required. The coefficients can be stored in any non-volatile memory or

data storage device 214 associated with the monitor 200. The importance is that the coefficients are stored in a memory device associated 214 with the monitor 200 so that the coefficients can be read at a later time and provided to the video driver circuitry or software that provides display signals to the monitor 200.

The monitor 200 is disconnected from the VGA connector 202 and moves down the assembly line with its display characterizing information stored in the DDC memory 214. The next monitor on the assembly line is then moved into position to be tested and measured to determine its voltage to brightness transfer function coefficients.

As a result of the present system and method for measuring and storing voltage to brightness transfer function coefficients in each monitor or CDD as it is manufactured, each monitor can provide its transfer function information to the computer system it is eventually connected to and thereby provide a

standardized voltage to brightness compensation. The result being that every monitor will provide a color picture that looks the same as any other monitor equipped with transfer function coefficients that are utilized by a video driver. The input voltage to the monitor can be modified by the video driver circuitry of the attached computer to provide the standardized color brightness. In essence the video driver can modify its output in accordance with the stored coefficients so that the video input to the monitor will result in a standardized color and color brightness output.

Although a preferred embodiment of the method and apparatus of the present invention has been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from

the spirit of the invention as set forth and defined by the following claims.

WHAT IS CLAIMED IS:

1. A system for computing equation coefficients to represent an input-output color characteristic of a color display device, said system comprising:

a signal generator for generating an output signal that can be used by a color display device to produce a predetermined pattern on a screen of said color display device;

a general purpose computer providing a plurality of first outputs to said signal generator such that said signal generator incrementally changes said output signal from a first extreme to a second extreme such that a first color can be displayed on said color display device in said predetermined pattern, said single color being displayed incrementally from a first brightness level to a second brightness level;

a photometer device positioned to measure the incremental brightness levels that can be displayed on said color display device, said photometer providing a

brightness data for each incremental brightness level to said general purpose computer;

said general purpose computer correlates said first outputs with said brightness data to further calculate a plurality of coefficients that represent the signal input-to-first color output relationship of said color display device.

2. The system for computing of claim 1, wherein said general purpose computer further can provide said plurality of coefficients to said color display device.

3. The system for computing of claim 1, wherein said coefficients are for a polynomial equation that represents the signal input-to-first color output relationship of said color display device.

4. The system for computing of claim 1, wherein said plurality of coefficients can be communicated to

said color display device for storage in a data storage device associated with said color display device.

5. The system for computing of claim 1, wherein said plurality of coefficients can be utilized in a third order polynomial equation which predicts the brightness of said first color to within 0.3 foot-lamberts for each input signal for said color display device.

6. The system for computing of claim 1, wherein said first color is at least one of red, green, and blue.

7. The system for computing of claim 1 wherein said color display device can be at least one of a VGA monitor, a MultiSync monitor, a flat panel NCD display, a flat panel SPU display, a flat panel LCD display, a reflective LCD display, and a FED display device.

8. A method of calculating a mathematical representation of the signal input-to-color brightness output relationship of a color display monitor, said method comprising the steps of:

providing input signals having predetermined incremental changes between said input signals to a color display device such that said color display device produces a predetermined pattern on the color display device's screen;

measuring a brightness of at least a portion of said predetermined pattern at each incremental change of said input signal and providing said measured brightness as brightness data to a general purpose computer;

correlating said input signals with said brightness data in said general purpose computer;

calculating coefficients of a polynomial representation, in said general purpose computer, of said correlated input signals to said brightness data;

storing said coefficients in a memory device associated with said color display device.

9. The method of claim 8, wherein said input signals represent at least one predetermined color that can be displayed on said color display device.

10. The method of claim 8, wherein prior to the step of providing a step of warming up said color display device is performed.

11. The method of claim 8, wherein said memory device associated with said color display device is a DDC memory.

12. A color display device adapted to provide a plurality of coefficients to a color display device driver circuit, said coefficients being related to a signal-input-to-brightness-output transfer function of

said color display device, said color display device comprising:

input/output circuitry for connecting said color display device to a general purpose computer;

a display screen in communication with said input/output circuitry;

a data storage device, in communication with said input/output circuitry, for storing, at least, a plurality of coefficients for a signal-input-to-brightness-output transfer function, said plurality of coefficients being calculated after incremental signals are provided to said color display monitor, via said input/output circuit, such that a predetermined pattern is displayed on said display screen, a brightness data of said predetermined pattern is measured and correlated with each said incremental signal, a transfer function, having coefficients, is calculated based on said correlation of said incremental signals and said brightness data, said coefficients then being stored in

said memory device, said coefficients being available to a color display device driver circuit when said color display device is connected to a general purpose computer.

13. The color display device of claim 12, wherein said transfer function is a polynomial equation.

14. The color display device of claim 12, wherein said transfer function is a third order polynomial equation.

15. The color display device of claim 12, wherein said color display device is a screen utilized by at least one of a personal computer, laptop computer, and computer monitor.

16. A computer system comprising:

a general purpose computer, said general purpose computer comprising a color display device driver;

a color display device connected to said general purpose computer, said color display device comprising a data storage device containing data that can be provided to said color display device driver in order to aide the standardization of a color brightness.

17. The computer system of claim 16, wherein said data comprises coefficients to a polynomial transfer function that describes a relationship between an input signal to said color display device and a color brightness on a screen of said color display device.

18. The computer system of claim 16, wherein said data storage device is memory device.

19. The computer system of claim 16, wherein said memory device is a DDC memory associated said color display device.

ABSTRACT OF THE DISCLOSURE

A method and apparatus determines a transfer function which defines a signal input-to-brightness output of a color display device. Coefficients or transfer function related data are stored in the color display device for use by a video driver so that the color of the display device is standardized.

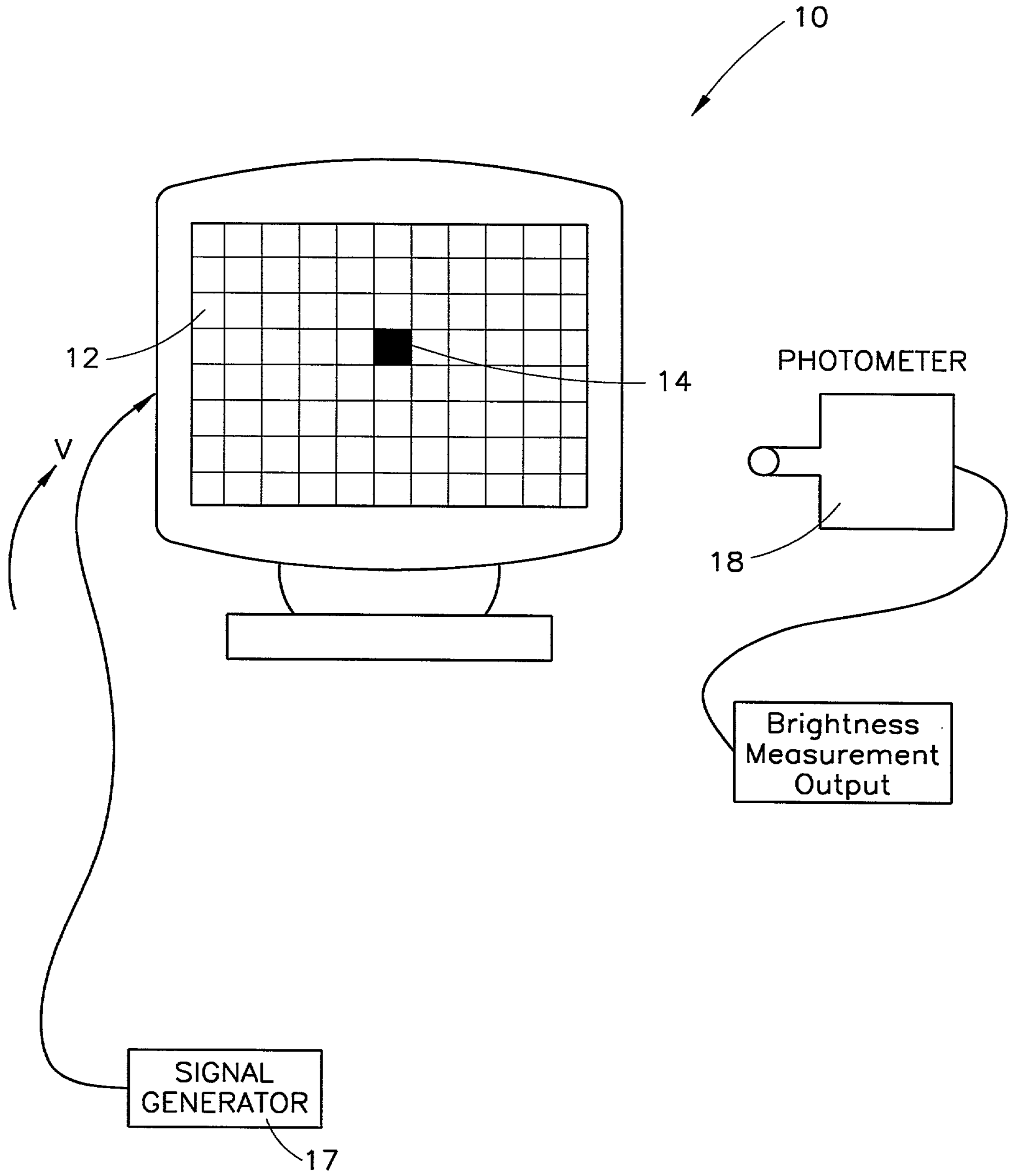
10
12
14
V
PHOTOMETER
18
Brightness
Measurement
Output
SIGNAL
GENERATOR
17

FIG. 1

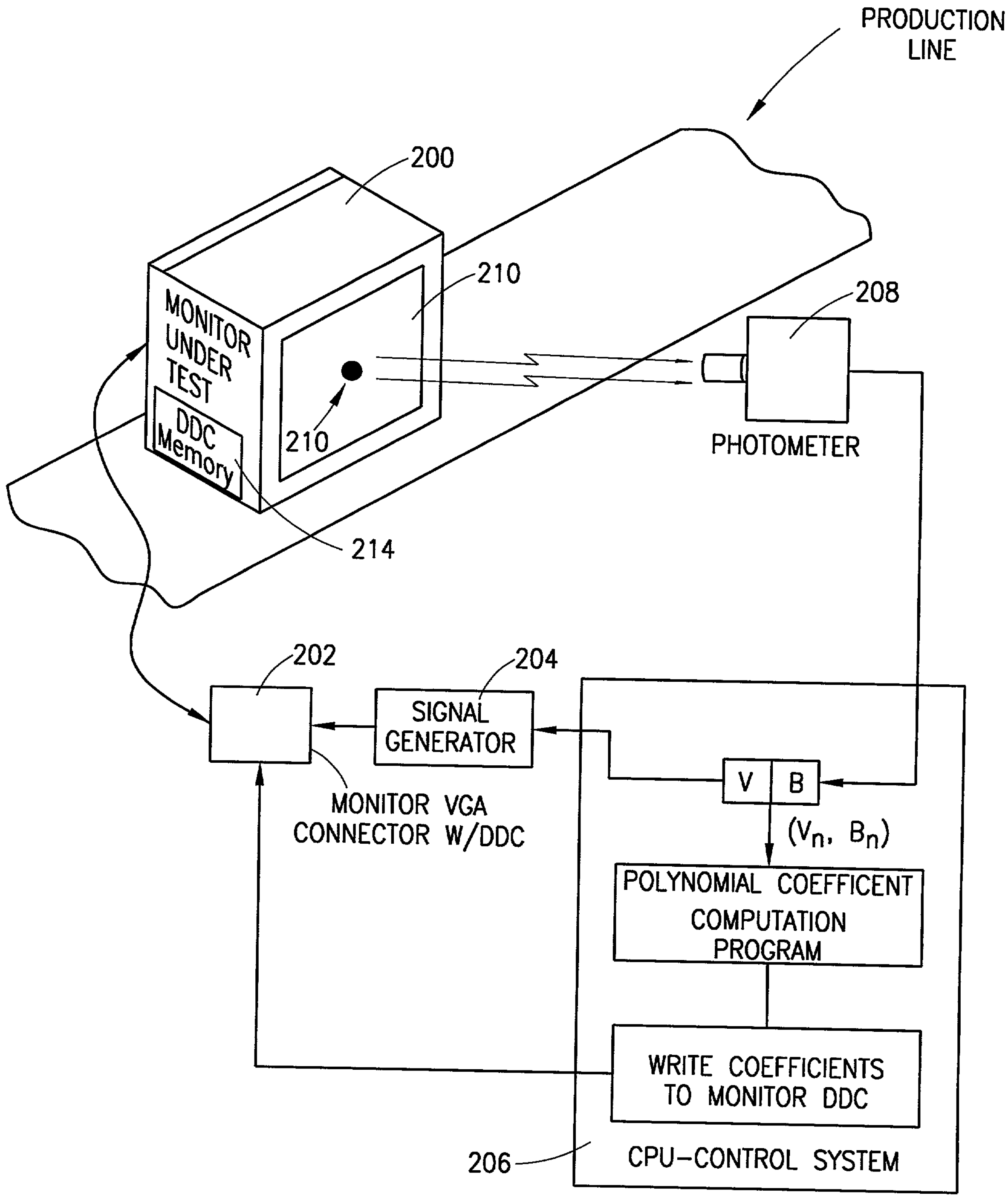
PRODUCTION LINE
200
210
208
MONITOR UNDER TEST
DDC Memory
210
PHOTOMETER
214
202
204
SIGNAL GENERATOR
V
B
(V_n, B_n)
MONITOR VGA CONNECTOR W/DDC
POLYNOMIAL COEFFICENT COMPUTATION PROGRAM
WRITE COEFFICIENTS TO MONITOR DDC
206
CPU-CONTROL SYSTEM

FIG. 2

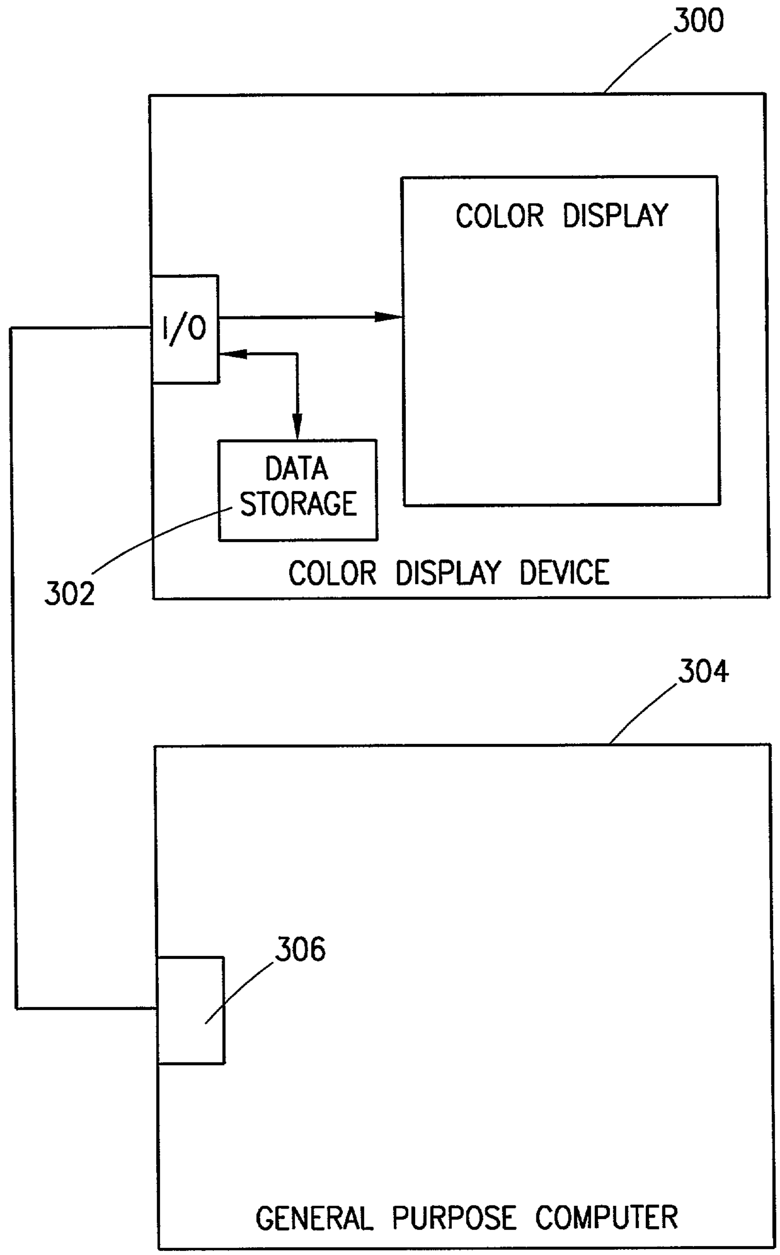
300
COLOR DISPLAY
I/O
DATA STORAGE
302
COLOR DISPLAY DEVICE
304
306
GENERAL PURPOSE COMPUTER

FIG. 3

Express Mail Label No.
EL 269320415 US

Attorney Docket No.: 27757-00403
P98-2337

DECLARATION

JOINT INVENTOR
ORIGINAL

As a below named inventor, I hereby declare that: my residence, post office address, and citizenship are as stated below next to my name. I believe I am the original, first, and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

A METHOD APPARATUS FOR COMPUTING OPTIMUM POLYNOMIAL COEFFICIENTS TO REPRESENT THE INPUT-OUTPUT CHARACTERISTICS OF A COLOR DISPLAY DEVICE

as described in the specification [X] attached or [___] of patent Application Serial No. ____________________

filed ____________________ and amended on ____________________.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above; that I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application; that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representative or assigns more than twelve months prior to this application; and that I acknowledge the duty to disclose information of which I am aware which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations § 1.56(a). Such information is material when it is not cumulative to information already of record or being made of record in the application, and

(1) it establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or
(2) it refutes, or is inconsistent with, a position the applicant has taken or may take in:
(i) opposing an argument of unpatentability relied on by the Office, or
(ii) asserting an argument of patentability.

I hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificates listed below and have also identified below any foreign application(s) having a filing date before that of the application(s) on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE OF FILING	PRIORITY CLAIMED UNDER 35 USC 119
			☐ YES ☐ NO

I hereby claim the benefit under Title 35 United States Code § 120 of any United States application(s) listed below and, insofar as any subject matter of any claim of this application is not disclosed in the prior United States Application, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations § 1.56(a) which occurred between the filing date of the prior application and the national PCT international filing date of this application:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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P98-2337

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant/Patentee:		§	
	Henry M. D'Souza et al.	§	
Filed:	Concurrently Herewith	§	*Atty File:* 27757/00403 Compaq Docket No.: P98-2337
Serial No.:	Not Yet Assigned	§	
For:	A METHOD APPARATUS FOR COMPUTING OPTIMUM POLYNOMIAL COEFFICIENTS TO REPRESENT THE INPUT-OUTPUT CHARACTERISTICS OF A COLOR DISPLAY DEVICE	§	

POWER OF ATTORNEY BY ASSIGNEE

Under the provisions of 37 C.F.R. § 3.71, the undersigned assignee of record of the entire interest in the above-identified patent/patent application by virtue of an assignment recorded (check as applicable):

- ☒ Concurrently Herewith
- ☐ Date Recorded ____________
- ☐ Reel ______ Frame ______

elects to conduct the prosecution of the application/maintenance of the patent to the exclusion of the inventor(s). The undersigned hereby declares that she has reviewed the above-referenced assignment and hereby declares that, to the best of her knowledge, title is in the Assignee, and further declares that all statements made herein of her own knowledge are true and that all statements made on information and belief are believed to be true. The assignee hereby revokes any previous powers of attorney and appoints the following to prosecute this application/maintain this patent and transact all business in the Patent and Trademark Office connected therewith:

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Authorized To Sign This Document On Behalf Of
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Pursuant To Board Of Directors Resolution
Date July 28, 1989

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